

Exploring Habitability, Hydrology, and Climate Change on Mars at Columbus Crater

Abstract #1041

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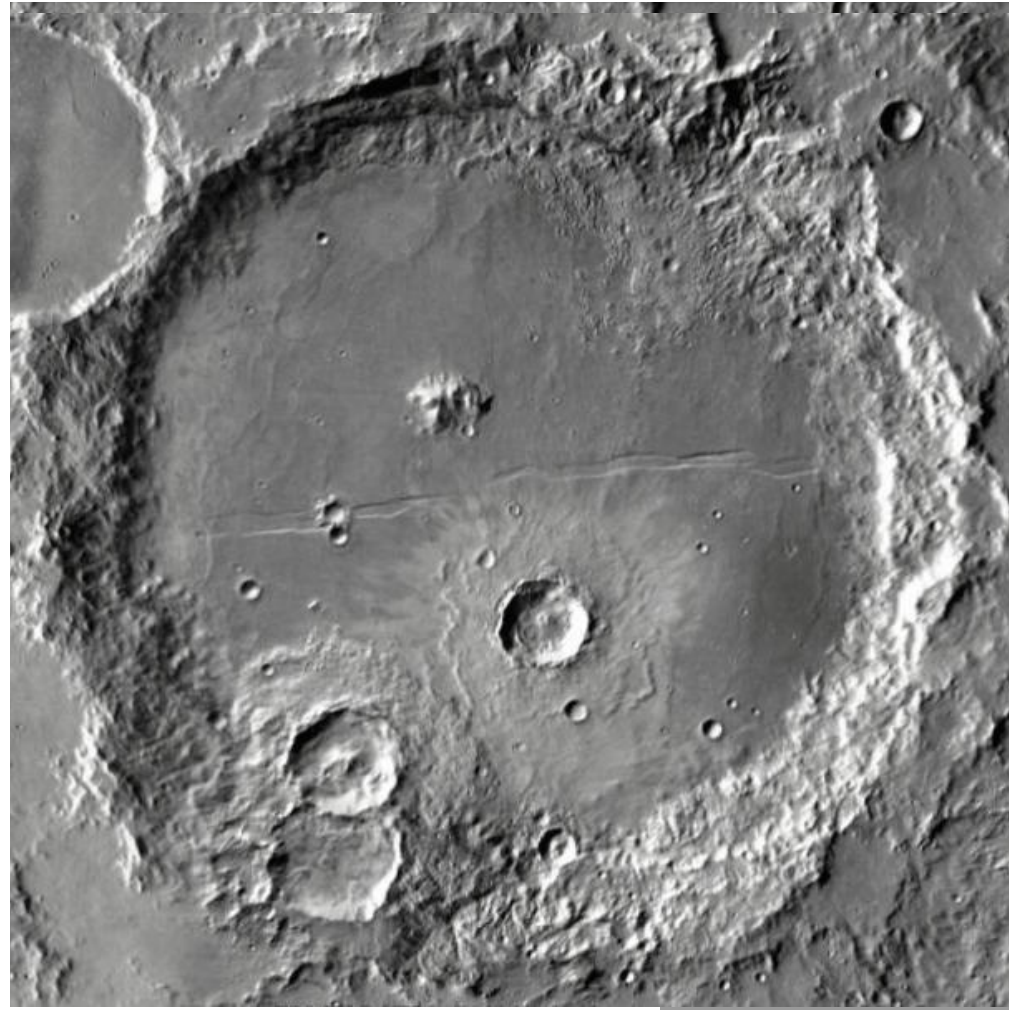
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Columbus Crater: Overview

1st EZ Workshop for Human Missions to Mars

- Ground-water filled paleolake basin
- ~110 km in diameter
- Estimated 1.5 km depth of sedimentary and/or volcanic infill
- Excellent crater retention for age dating
- Diversity of Noachian & Hesperian aged deposits and outcrops
- High diversity of aqueous mineral deposits

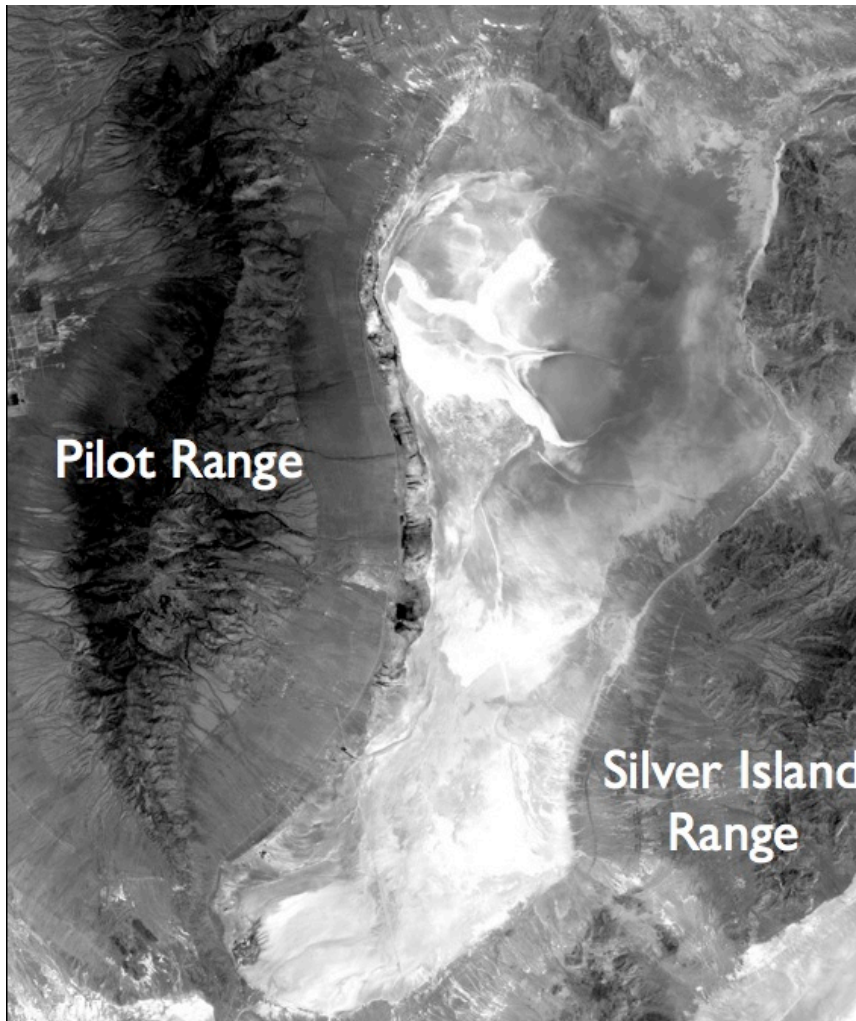


Columbus Crater

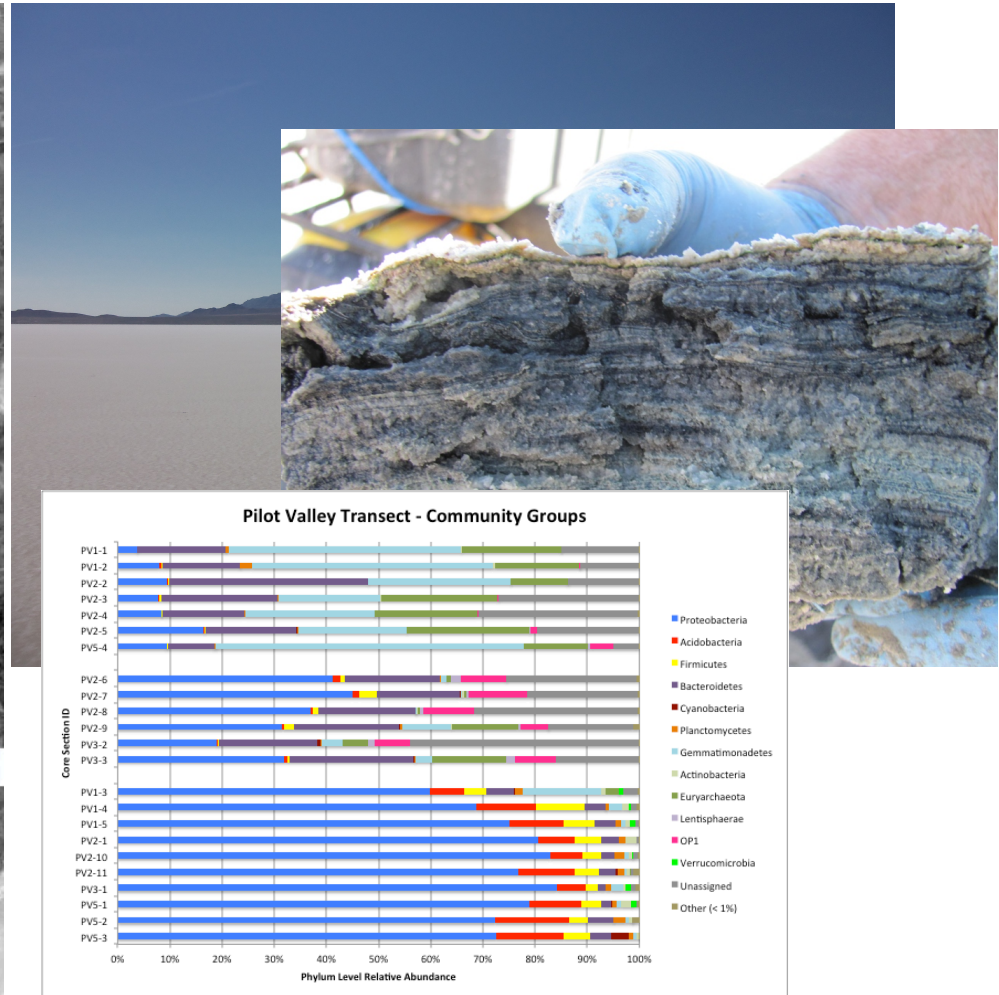
Wray et al., 2011

Analog Studies

1st EZ Workshop for Human Missions to Mars



Lynch et al., 2015



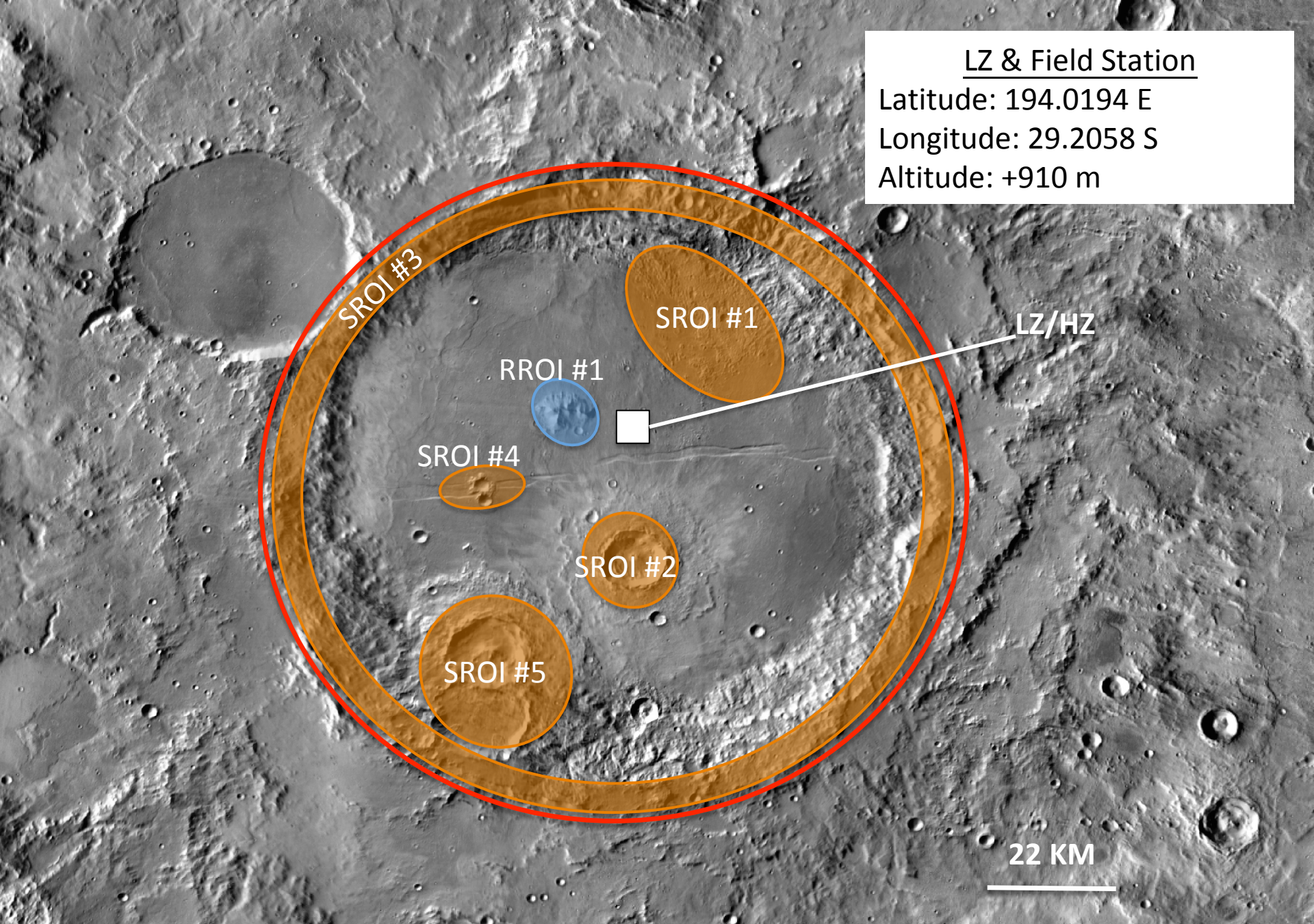
Columbus Crater

LZ & Field Station

Latitude: 194.0194 E

Longitude: 29.2058 S

Altitude: +910 m



Columbus Crater

Science ROI(s) Rubric

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Site Factors					SROI1	SROI2	SROI3	SROI4	SROI5	RROI1	EZ SUM	
Science Site Criteria	AstroBio	Threshold	AND/OR	Potential for past habitability	●	●	●	●	●	●	(6,0)	
				Potential for present habitability/refugia		?	?	?	?	?	(0,0)	
		Qualifying	Potential for organic matter, w/ surface exposure			●	○	●	●	●	●	(5,1)
	Atmospheric Science	Threshold	Noachian/Hesperian rocks w/ trapped atmospheric gases			●	●	●	●	●	●	(6,0)
			Qualifying	Meteorological diversity in space and time			●		●		●	●
		High likelihood of surface-atmosphere exchange			●		●		●		(3,0)	
		Amazonian subsurface or high-latitude ice or sediment			○	○	○	○	○	○	(0,6)	
		High likelihood of active trace gas sources			?	?	?	?	?	?	(0,0)	
		Geoscience	Threshold	Range of martian geologic time; datable surfaces			●	●	●		●	●
	Evidence of aqueous processes			●	●	●	●	●	●	(6,0)		
	Potential for interpreting relative ages			●	●	●	●	●	●	(6,0)		
	Qualifying		Igneous Rocks tied to 1+ provinces or different times			●	●		●			(3,0)
			Near-surface ice, glacial or permafrost			?	?	?	?	?	?	(0,0)
			Noachian or pre-Noachian bedrock units					○			○	(0,2)
			Outcrops with remnant magnetization					○			○	(0,2)
			Primary, secondary, and basin-forming impact deposits				●		●	●		(3,0)
Structural features with regional or global context						●			(1,0)			
Diversity of aeolian sediments and/or landforms			●	●	●				(3,1)			

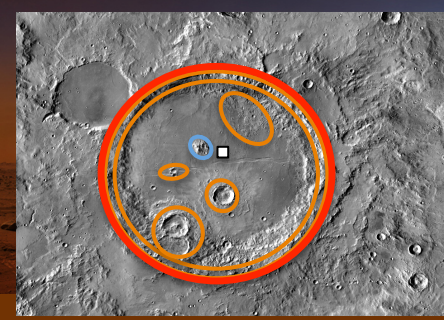
Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Resource ROI(s) Rubric

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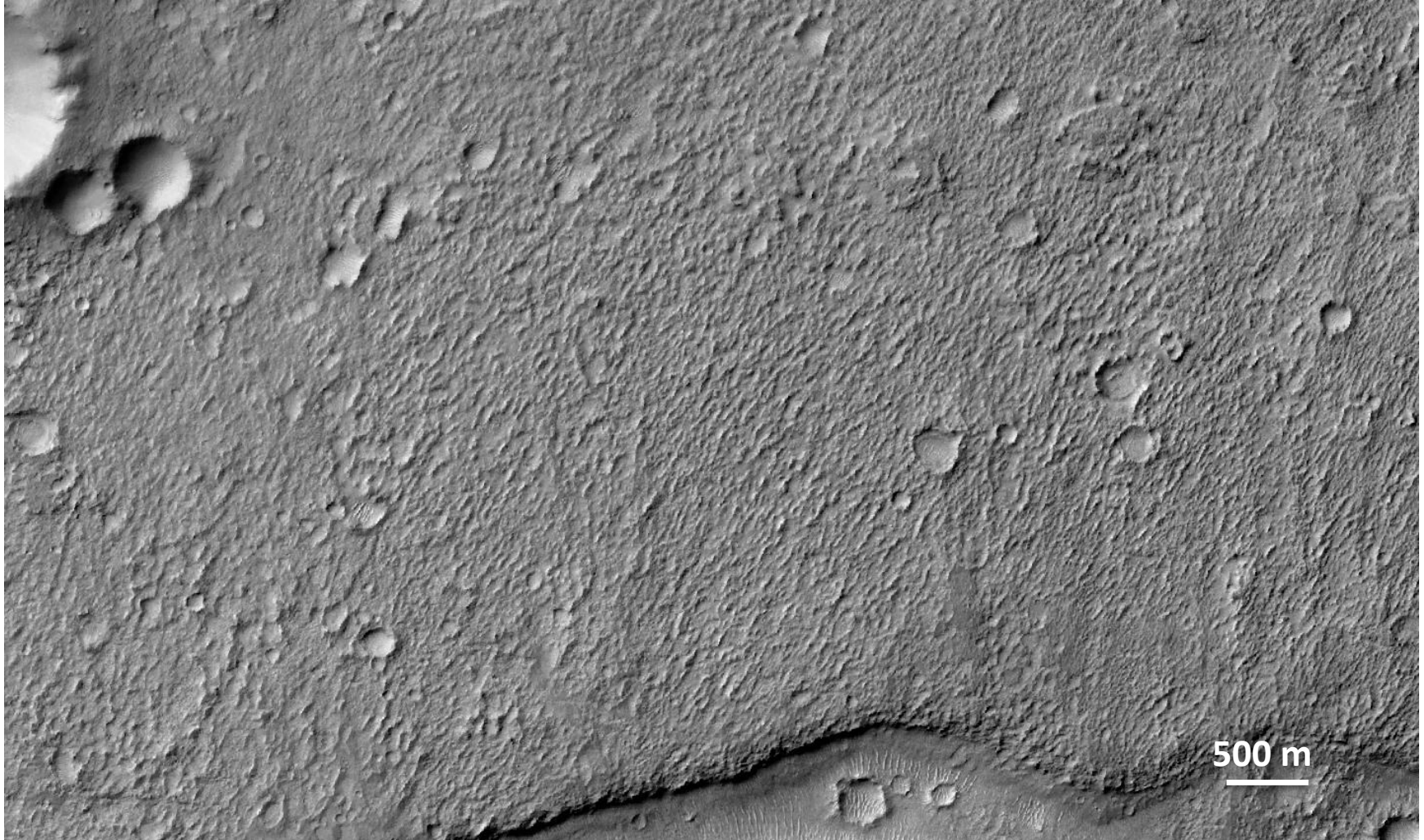
Site Factors				RROI	LZ/HZ	EZ SUM
ISRU and Civil Engineering Criteria	Engineering	Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)		●	●	(2,0)
	Water Resource	Threshold	AND/OR Potential for ice or ice/regolith mix			(0,0)
			Potential for hydrated minerals	●		(1,0)
			Quantity for substantial production	?		(0,0)
			Potential to be minable by highly automated systems	?		(0,0)
			Located less than 3 km from processing equipment site	○		(0,1)
			Located no more than 3 meters below the surface	●		(0,1)
			Accessible by automated systems	○		(0,1)
		Qualifying	Potential for multiple sources of ice, ice/regolith mix and hydrated minerals			(0,0)
			Distance to resource location can be >5 km	●		(1,0)
			Route to resource location must be (plausibly) traversable	●		(1,0)
	Civil Engineering	Threshold	~50 sq km region of flat and stable terrain with sparse rock distribution		○	(0,1)
			1–10 km length scale: <10°		○	(0,1)
			Located within 5 km of landing site location		○	(0,1)
		Qualifying	Located in the northern hemisphere			(0,0)
			Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	●		(1,0)
			Utilitarian terrain features	?		(0,0)
	Food Production	Qualifying	Low latitude	●		(1,0)
			No local terrain feature(s) that could shadow light collection facilities			(0,0)
			Access to water			(0,0)
			Access to dark, minimally altered basaltic sands	○		(0,1)
	Metal/Silicon Resource	Threshold	Potential for metal/silicon	●		(1,0)
			Potential to be minable by highly automated systems	○		(0,1)
			Located less than 3 km from processing equipment site			(0,0)
			Located no more than 3 meters below the surface	●		(1,0)
			Accessible by automated systems	○		(0,1)
		Qualifying	Potential for multiple sources of metals/silicon	●		(1,0)
			Distance to resource location can be >5 km	●		(1,0)
			Route to resource location must be (plausibly) traversable	●		(1,0)

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

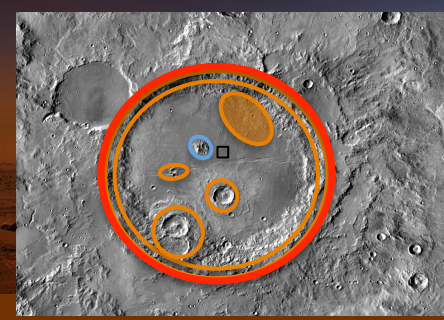


LZ & Field Station

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Columbus Crater



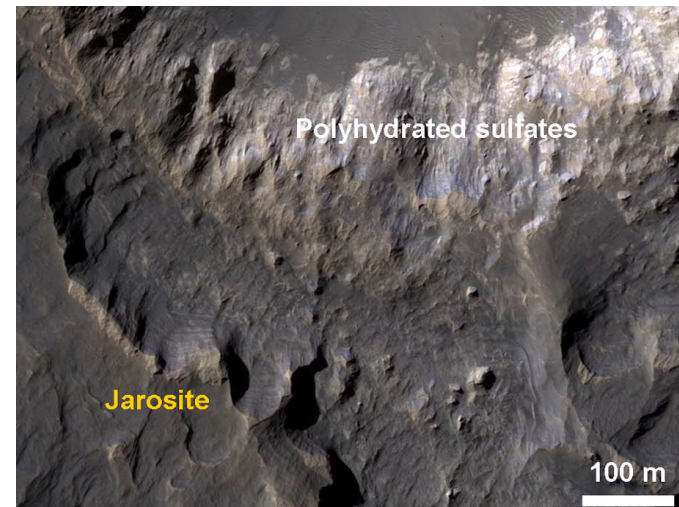
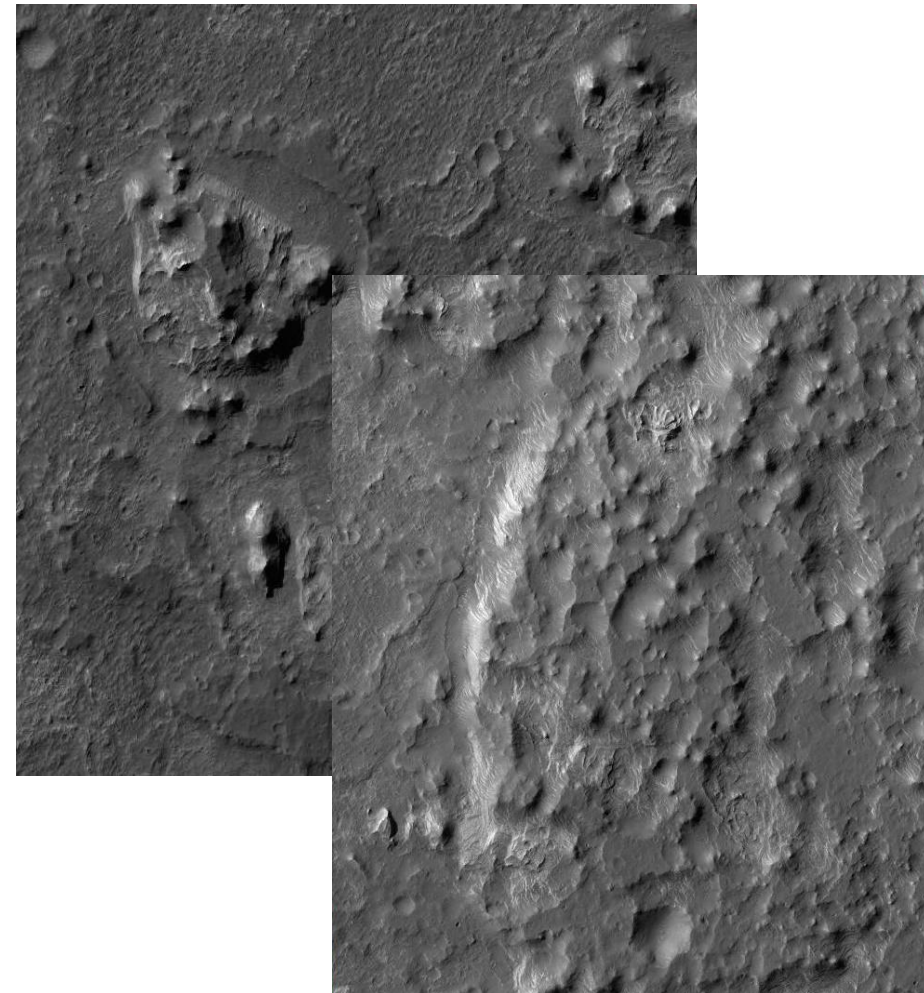
Science ROI 1

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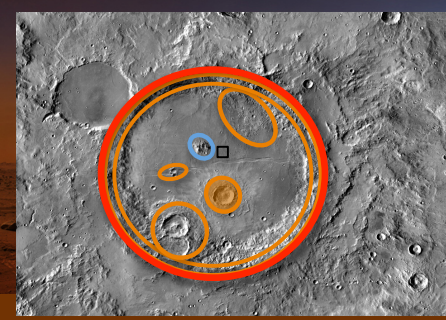
Northeastern Shore

- 194.2591° E, -28.883° N
- Most exposed light toned units & highest diversity of aqueous mineral deposits



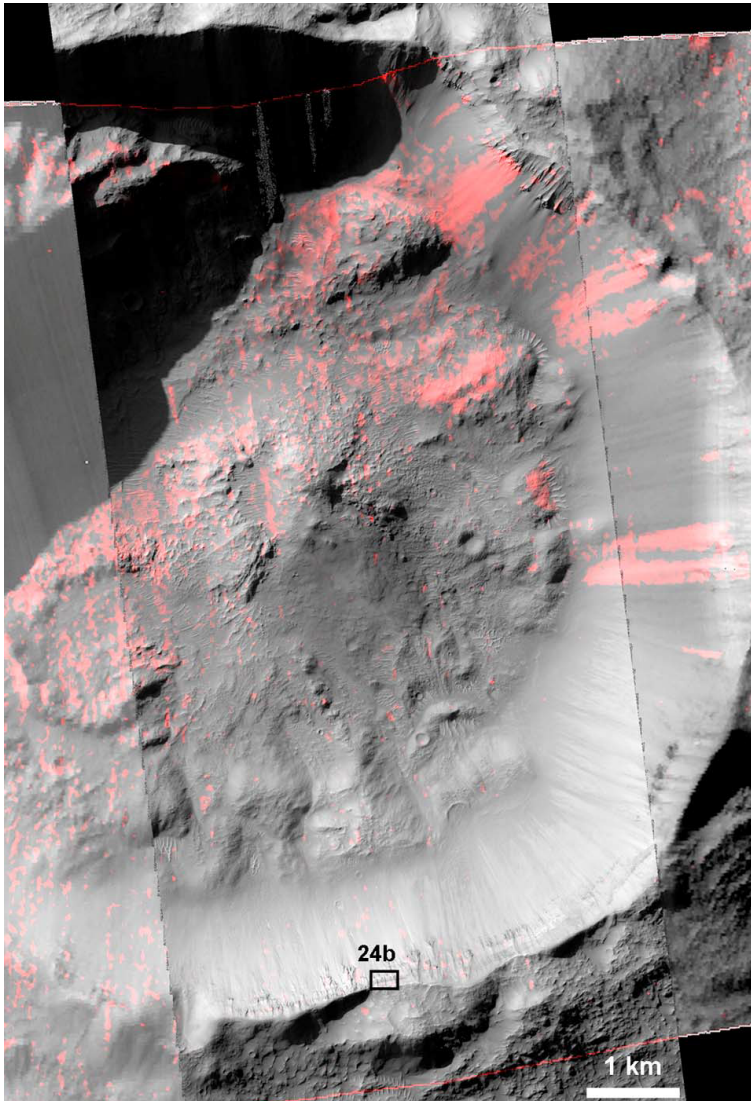
Columbus Crater

Wray et al., 2011



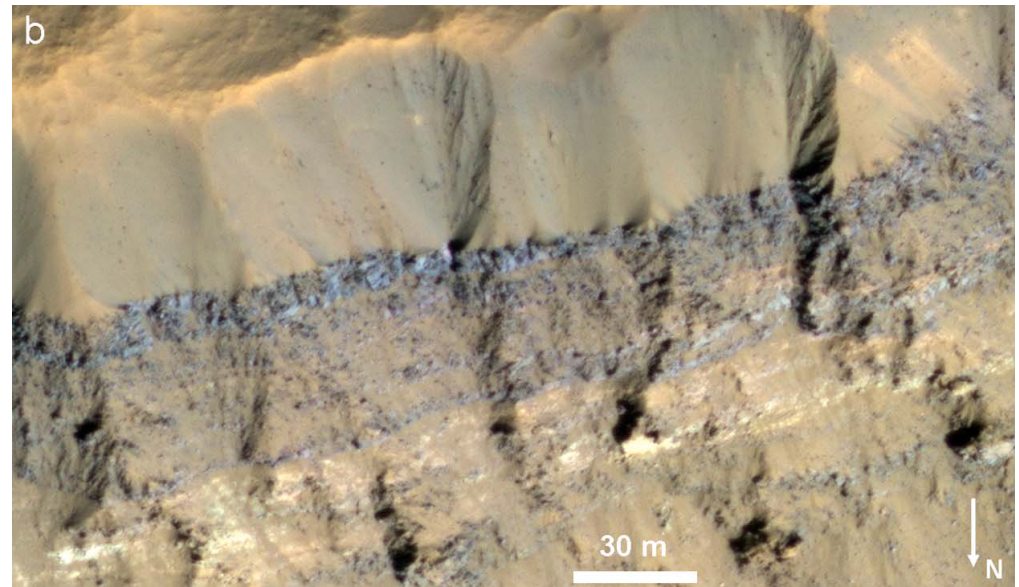
Science ROI 2

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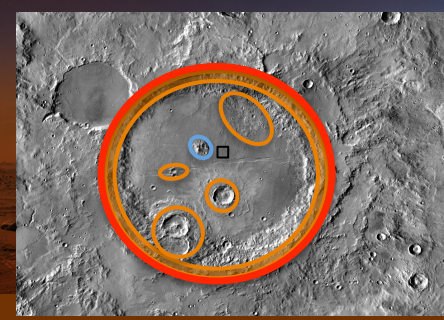


D11 Crater

- 194.2591° E, 29.581° S
- Stratigraphic context
- Possible RSL



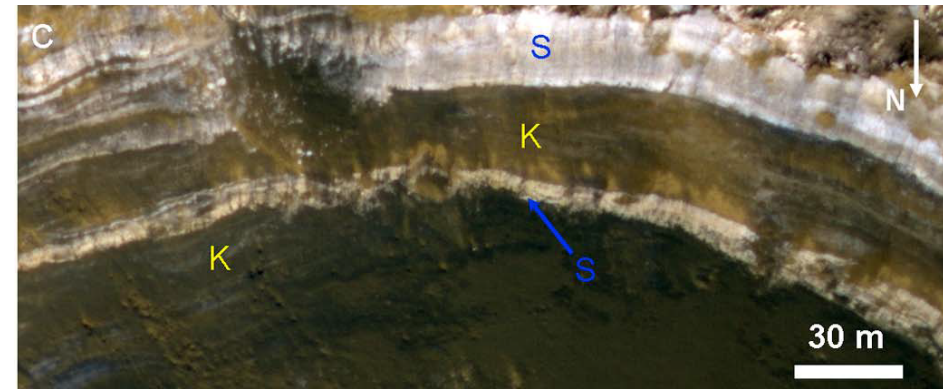
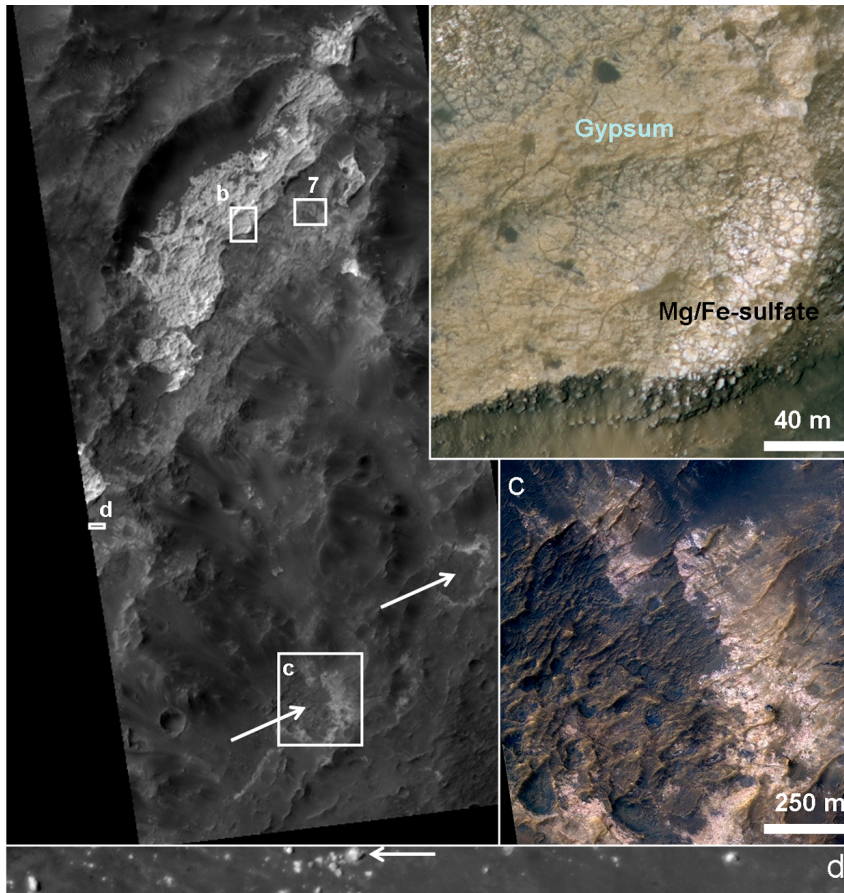
Columbus Crater



Science ROI 3

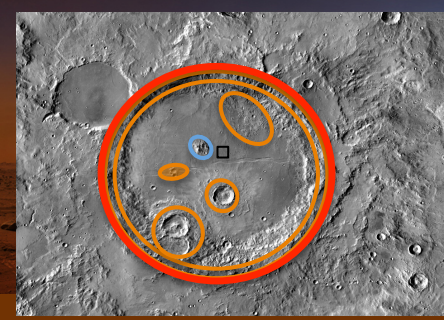
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Bathtub Ring



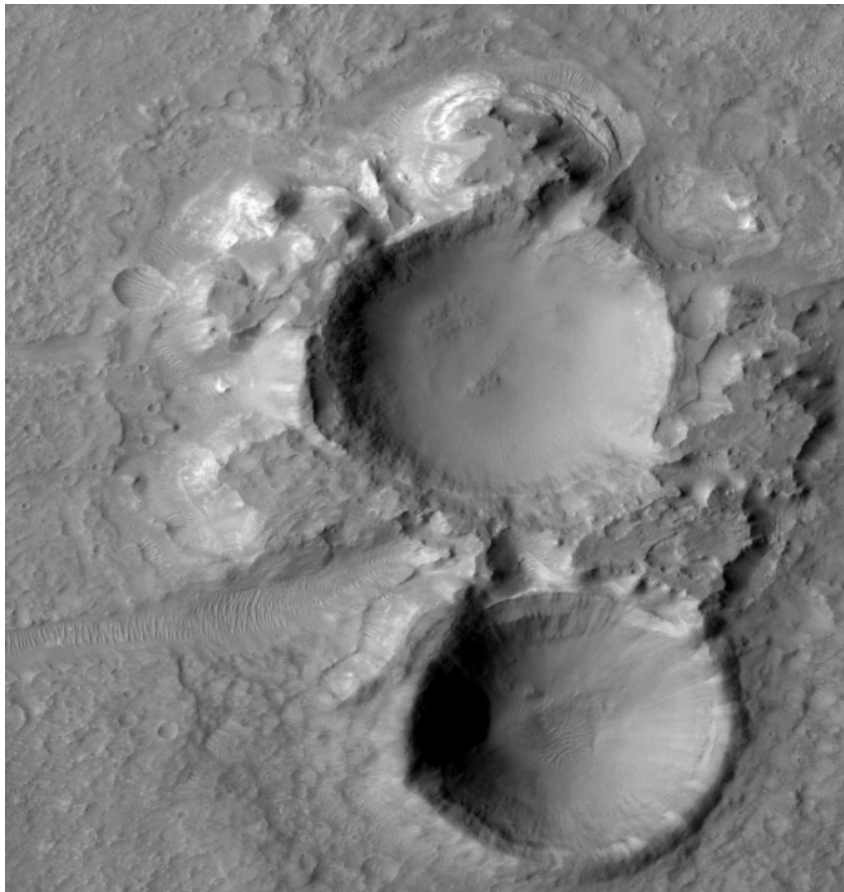
Wray et al., 2011

Columbus Crater



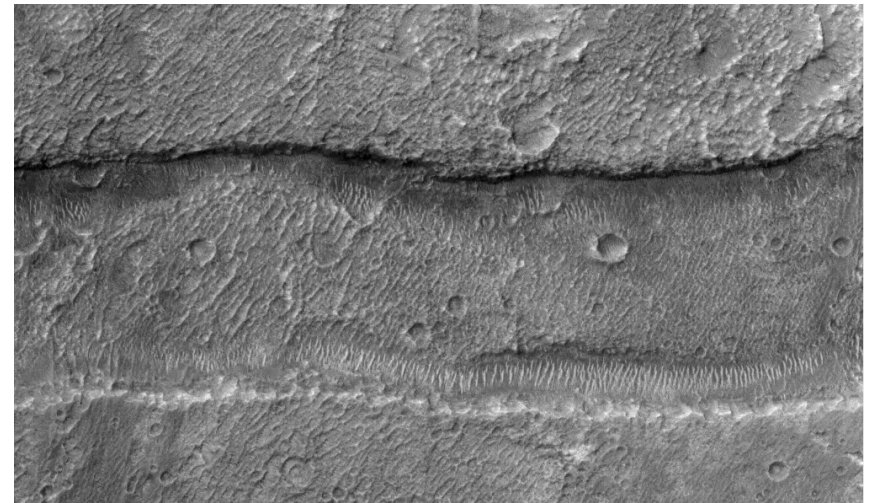
Science ROI 4

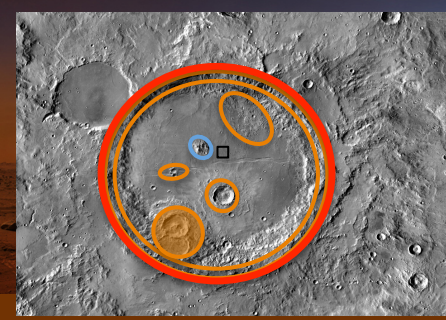
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Pedestal Crater

- 193.603° E, 29.345° S





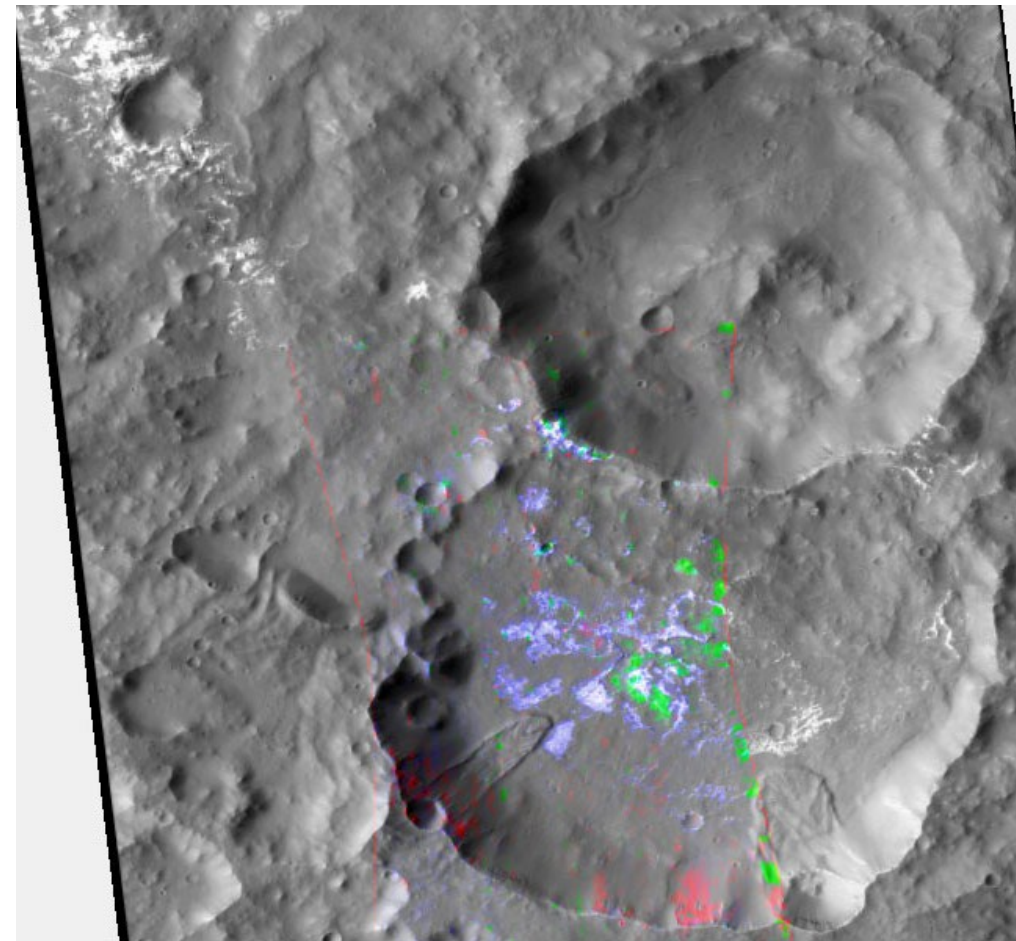
Science ROI 5

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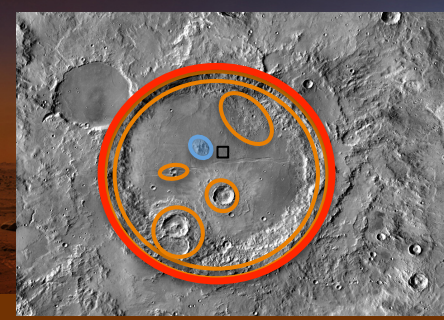


Dual Craters

- 193.599° E, 29.973° S

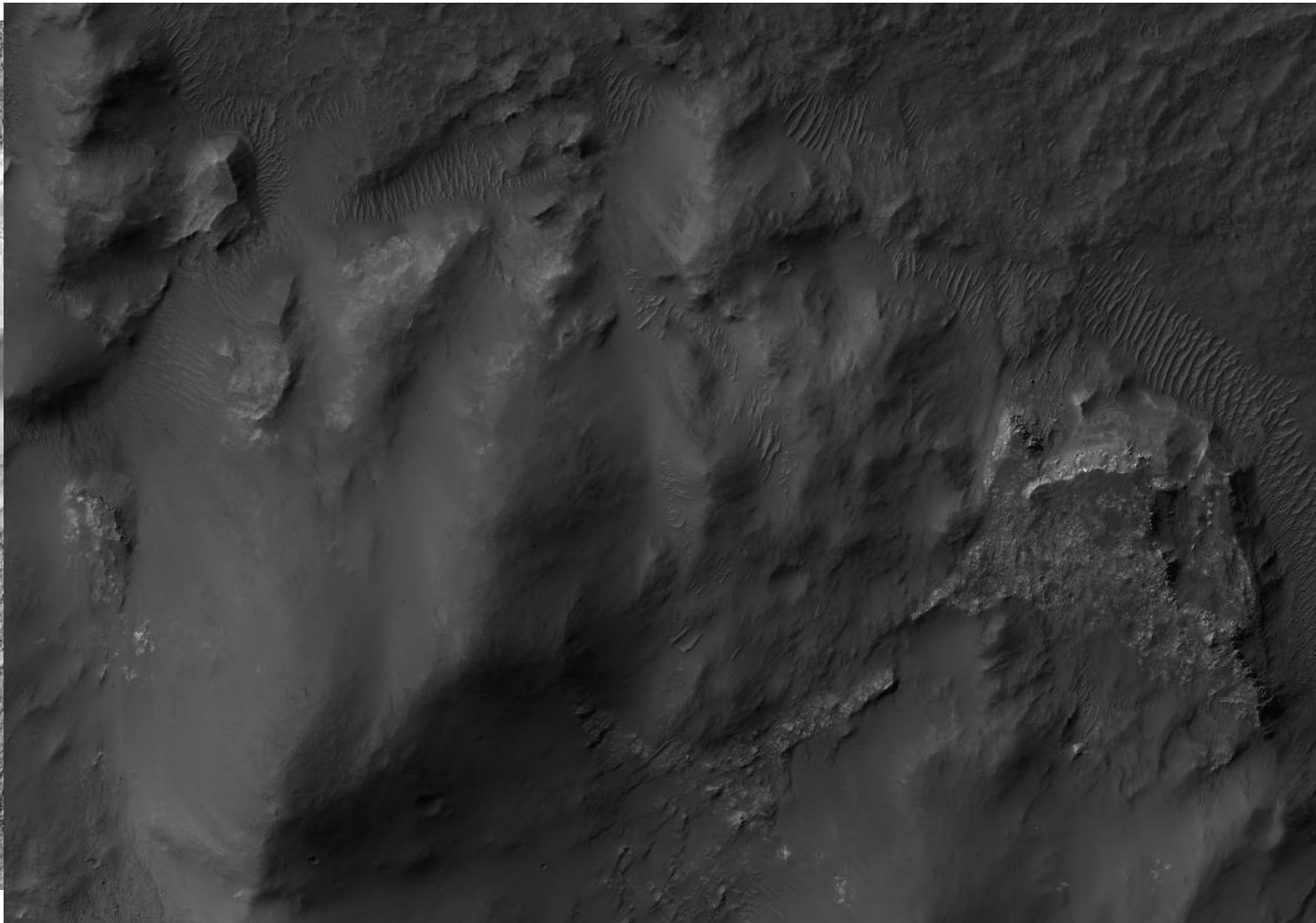
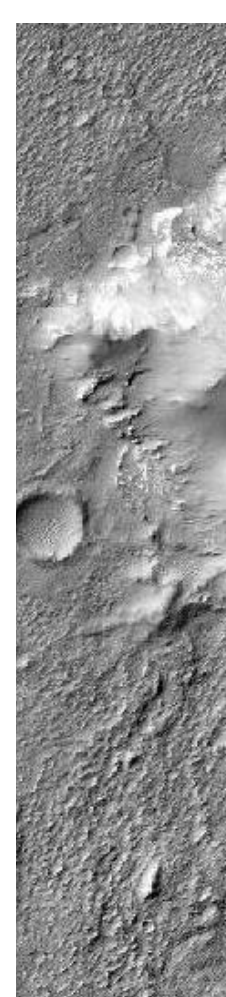


Columbus Crater



Resource ROI 1

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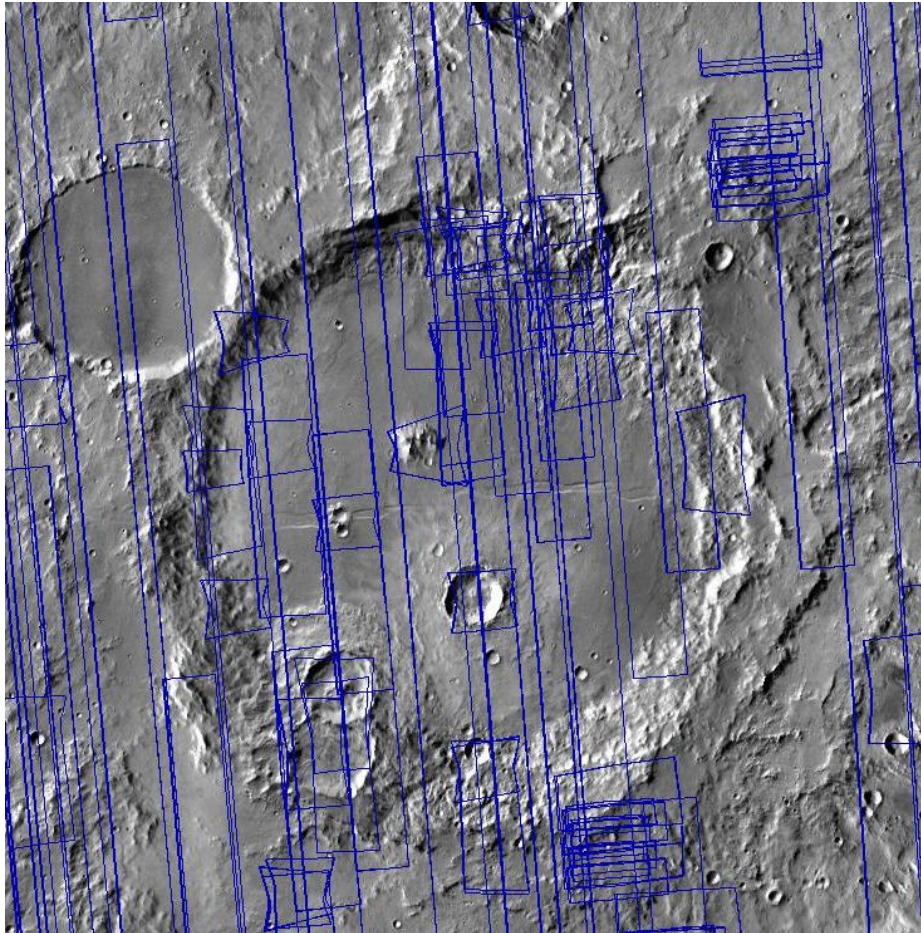


Columbus Crater

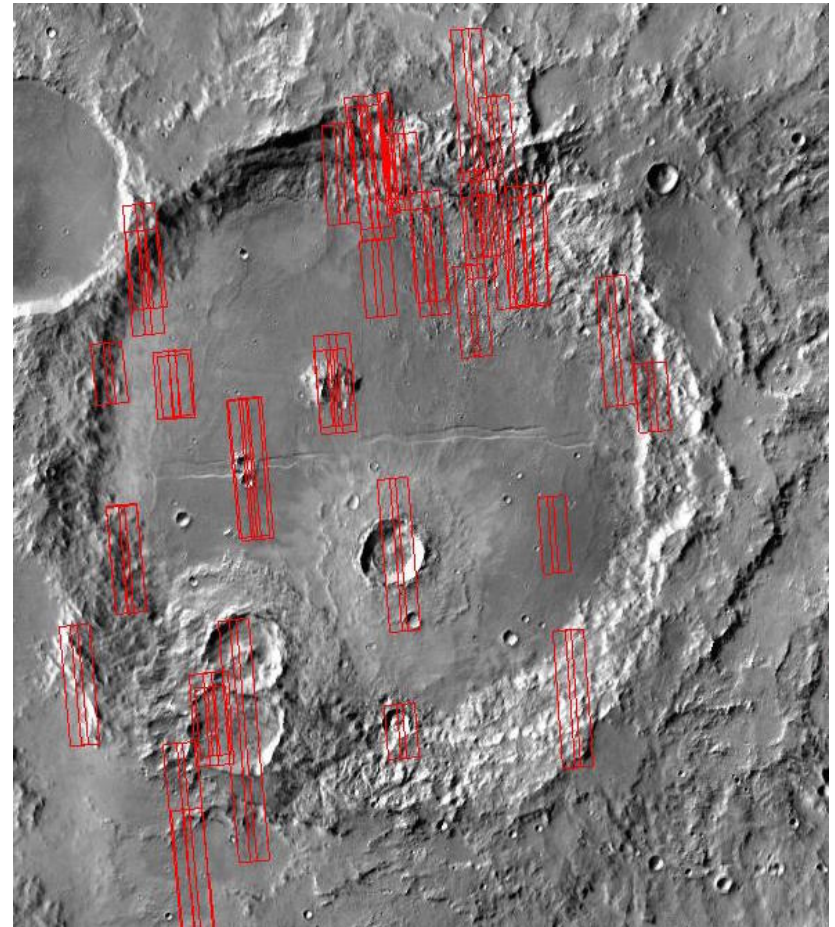


Data Coverage

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CRISM Coverage



HiRISE Coverage

Highest Priority EZ Data Needs

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- Science Coverage
 - HRSC coverage of crater rim & basin floor
 - CRISM coverage of the Northwest crater Rim
 - General HiRISE coverage of the crater rim and basin floor
- Resource Coverage
 - General HiRISE coverage of basin floor